Appendix A

RADIATION DOSE CALCULATION METHODS AND ASSUMPTIONS

The routine operation of L-Reactor and its support facilities will result in releases of radioactive materials. This appendix describes the methods and assumptions used to determine the radiological impacts expected from normal operations of L-Reactor and its support facilities.

A.1 IMPACTS OF NORMAL OPERATIONS

The calculations of radiological doses to members of the public are based on methods recommended by the U.S. Nuclear Regulatory Commission (NRC) for licensing power reactors. The estimates of doses are based on detailed analyses of the sources, the rates of radioactive releases, and the pathways by which dispersed radioactive materials can result in exposure to people.

A.1.1 Radiation doses

The principal pathways by which radioactivity released from a facility can reach people are (1) exposure to nuclides in the air, in the water, or on the ground, (2) the inhalation of radioactivity, and (3) the ingestion of radioactivity in food and water. Figure A-1 shows these pathways.

The pathway and demographic parameters used to calculate radiation doses to maximally exposed individuals and populations from atmospheric releases were the values recommended in NRC Regulatory Guide 1.109, Revision 1 (NRC, 1977a).

Radiation dose estimates for the maximally exposed individual and for the population within 80 kilometers of the Savannah River Plant were calculated. The calculations were made for both the first and tenth years of L-Reactor operation; this is because it will take several years before the tritium inventory in the reactor, and hence, the resulting releases will reach equilibrium. The calculations were made on the basis of continuous exposure to the radionuclides released from the L-Reactor and its support facilities during these years.

A.1.1.1 Atmospheric releases

For airborne releases, annual average air and ground deposition concentrations (X/Q and D/Q, respectively) were calculated for each of 160 segments (16 wind direction sectors at 10 distances) within an 80-kilometer radius of the site and for the site boundaries, using the methods in NRC Regulatory Guide 1.111 (NRC, 1977b) and in the computer program XOQDOQ (Gall, 1976). The resulting values were used as input to the NRC code GASPAR (Eckerman et al., 1980), which implements the radiological exposure models of Regulatory Guide 1.109 (NRC, 1977a) to estimate dose commitments from atmospheric exposure pathways.

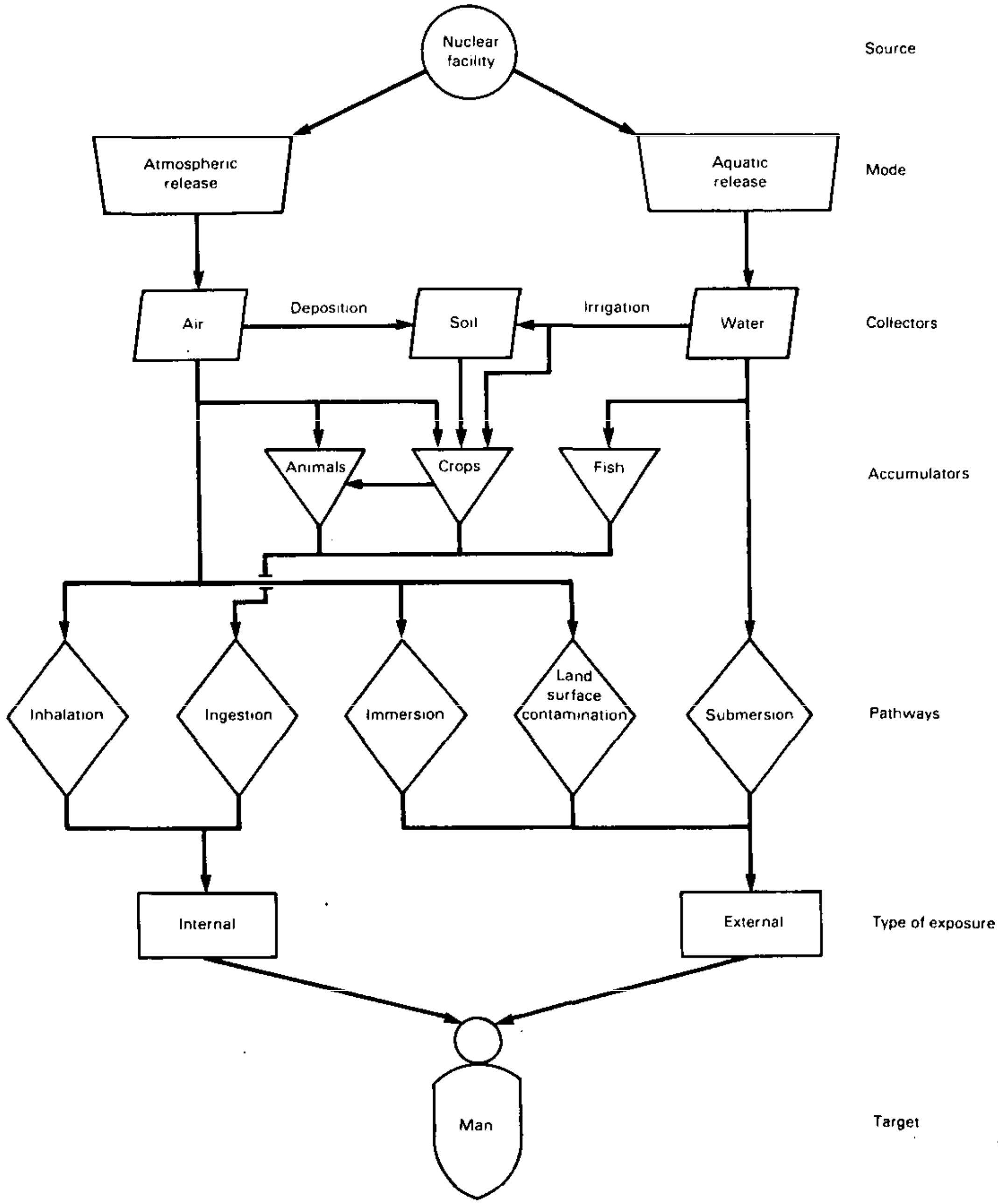

Figure A-1. Exposure pathways considered in radiological impact assessments.

Site-specific meteorological data were used to generate joint frequency distributions (JFDs) of wind speed, stability, and direction for input to the XOQDOQ computer code (Table A-1). Effluent release rates, population density and milk, meat, and vegetable production distribution data for the 16 wind direction sectors were used as input to GASPAR for calculating the population dose (Table A-2). Population projections for the year 2000 were used in this analysis.

Because the effects of internal radiation vary for different age groups, age-specific dose commitment factors were used to convert internal exposure to dose. The age groups considered were infant (0 to 1 year old), child (1 to 11 years old), teen (11 to 17 years old), and adult (17 years and older). The dose conversion factors used in the analysis are taken from an NRC document (Hoenes and Soldat, 1977). The doses from external radiation are the same for all age groups.

The following pathways were considered for the atmospheric dose assessment:

- Plume immersion
- Ground-plane exposure
- Inhalation
- Ingestion of contaminated foods (milk, vegetables, and meat)

Doses from these exposure pathways have been estimated for individuals located at the site boundary. Using a map of the Savannah River Plant with L-Reactor at the center of the population wheel, one location on the closest site boundary in each of the 16 22.5-degree wind-direction sectors was selected. The population wheel was centered at each of the four support facilities (i.e., the 200-F and -H separations areas, the 300-M fuel fabrication area, and the 400-D heavy-water rework area). A total of 29 boundary locations were selected so each of the 16 cardinal directions from each of the five facilities would be included. At each location, the doses from releases from L-Reactor and its support facilities were added to arrive at the total dose for that location. This method was used to determine the location at which a member of the public could receive the highest individual dose.

The following assumptions were made: (1) the exposed individual resides continuously at the location of highest potential exposure; (2) the residence provides a shielding factor of 0.7; and (3) the location is the point of origin for all foods consumed. All individual doses are 50-year dose commitments.

The total dose received by the exposed offsite population as a result of releases from L-Reactor and its support facilities is calculated by adding the individual dose commitments in the population. All population doses are 100-year environmental dose commitments (EDCs). The EDC concept is discussed later in this appendix.

Tables A-3 and A-4 list the results of the dose calculations to the maximally exposed individual and to the population within 80 kilometers of the Savannah River Plant from atmospheric releases from L-Reactor and its support facilities during the tenth year of L-Reactor operation.

Table A-1. Annual average meteorological dispersion/deposition parameters within 80 kilometers of SRP site center

Direction	Distance (km) 0-2	2-3	3-5	5-6	6-8	8-16	16-32	32-48	48-64	64-80
	Annual average χ/Q, no decay, undepleted (sec/m^3)									
N	1.98×10^{-5}	1.74×10^{-6}	5.72×10^{-7}	2.93×10^{-7}	1.83×10^{-7}	7.79×10^{-8}	2.93×10^{-8}	1.49×10^{-8}	9.57×10^{-9}	6.90×10^{-9}
NNE	2.05×10^{-5}	1.81×10^{-6}	5.96×10^{-7}	3.05×10^{-7}	1.91×10^{-7}	8.16×10^{-8}	3.08×10^{-8}	1.57×10^{-8}	1.01×10^{-8}	7.30×10^{-9}
NE	2.74×10^{-5}	2.42×10^{-6}	7.95×10^{-7}	4.07×10^{-7}	2.54×10^{-7}	1.08×10^{-7}	4.08×10^{-8}	2.08×10^{-8}	1.34×10^{-8}	9.66×10^{-9}
ENE	2.88×10^{-5}	2.53×10^{-6}	8.33×10^{-7}	4.27×10^{-7}	2.67×10^{-7}	1.14×10^{-7}	4.32×10^{-8}	2.20×10^{-8}	1.42×10^{-8}	1.03×10^{-8}
E	2.50×10^{-5}	2.19×10^{-6}	7.20×10^{-7}	3.68×10^{-7}	2.30×10^{-7}	9.77×10^{-8}	3.67×10^{-8}	1.86×10^{-8}	1.20×10^{-8}	8.65×10^{-9}
ESE	2.94×10^{-5}	2.58×10^{-6}	8.46×10^{-7}	4.32×10^{-7}	2.69×10^{-7}	1.14×10^{-7}	4.28×10^{-8}	2.17×10^{-8}	1.39×10^{-8}	1.00×10^{-8}
SE	2.05×10^{-5}	1.80×10^{-6}	5.92×10^{-7}	3.03×10^{-7}	1.89×10^{-7}	8.04×10^{-8}	3.02×10^{-8}	1.54×10^{-8}	9.89×10^{-9}	7.14×10^{-9}
SSE	1.21×10^{-5}	1.06×10^{-6}	3.50×10^{-7}	1.79×10^{-7}	1.22×10^{-7}	4.79×10^{-8}	1.81×10^{-8}	9.23×10^{-9}	5.96×10^{-9}	4.31×10^{-9}
S	1.02×10^{-5}	8.96×10^{-7}	2.96×10^{-7}	1.52×10^{-7}	9.49×10^{-8}	4.06×10^{-8}	1.54×10^{-8}	7.86×10^{-9}	5.08×10^{-9}	3.68×10^{-9}
SSW	1.88×10^{-5}	1.66×10^{-6}	5.49×10^{-7}	2.82×10^{-7}	1.77×10^{-7}	7.62×10^{-8}	2.91×10^{-8}	1.49×10^{-8}	9.68×10^{-9}	7.02×10^{-9}
SW	3.55×10^{-5}	3.14×10^{-6}	1.04×10^{-6}	5.34×10^{-7}	3.35×10^{-7}	1.44×10^{-7}	5.49×10^{-8}	2.82×10^{-8}	1.83×10^{-8}	1.32×10^{-8}
WSW	3.11×10^{-5}	2.75×10^{-6}	9.05×10^{-7}	4.64×10^{-7}	2.91×10^{-7}	1.24×10^{-7}	4.71×10^{-8}	2.40×10^{-8}	1.55×10^{-8}	1.12×10^{-8}
W	2.72×10^{-5}	2.40×10^{-6}	7.90×10^{-7}	4.05×10^{-7}	2.53×10^{-7}	1.08×10^{-7}	4.10×10^{-8}	2.09×10^{-8}	1.35×10^{-8}	9.74×10^{-9}
WNW	2.67×10^{-5}	2.36×10^{-6}	7.78×10^{-7}	4.00×10^{-7}	2.51×10^{-7}	1.07×10^{-7}	4.07×10^{-8}	2.08×10^{-8}	1.35×10^{-8}	9.74×10^{-9}
NW	2.25×10^{-5}	1.99×10^{-6}	6.55×10^{-7}	3.35×10^{-7}	2.10×10^{-7}	8.96×10^{-8}	3.38×10^{-8}	1.72×10^{-8}	1.11×10^{-8}	8.01×10^{-9}
NNW	2.84×10^{-5}	2.51×10^{-6}	8.28×10^{-7}	4.25×10^{-7}	2.66×10^{-7}	1.14×10^{-7}	4.32×10^{-8}	2.20×10^{-8}	1.42×10^{-8}	1.03×10^{-8}
	Annual average χ/Q, decay, undepleted, site annual decayed χ/Q for Xe-133m (sec/m^3)									
N	1.97×10^{-5}	1.72×10^{-6}	5.60×10^{-7}	2.84×10^{-7}	1.76×10^{-7}	7.29×10^{-8}	2.58×10^{-8}	1.21×10^{-8}	7.27×10^{-9}	4.92×10^{-9}
NNE	2.04×10^{-5}	1.78×10^{-6}	5.81×10^{-7}	2.94×10^{-7}	1.82×10^{-7}	7.55×10^{-8}	2.65×10^{-8}	1.23×10^{-8}	7.32×10^{-9}	4.90×10^{-9}
NE	2.73×10^{-5}	2.39×10^{-6}	7.78×10^{-7}	3.95×10^{-7}	2.45×10^{-7}	1.02×10^{-7}	3.62×10^{-8}	1.71×10^{-8}	1.03×10^{-9}	6.99×10^{-9}
ENE	2.86×10^{-5}	2.49×10^{-6}	8.13×10^{-7}	4.13×10^{-7}	2.56×10^{-7}	1.07×10^{-7}	3.77×10^{-8}	1.78×10^{-8}	1.07×10^{-8}	7.20×10^{-9}
E	2.49×10^{-5}	2.17×10^{-6}	7.04×10^{-7}	3.57×10^{-7}	2.21×10^{-7}	9.15×10^{-8}	3.23×10^{-8}	1.52×10^{-8}	9.12×10^{-9}	6.18×10^{-9}
ESE	2.92×10^{-5}	2.54×10^{-6}	8.26×10^{-7}	4.18×10^{-7}	2.58×10^{-7}	1.07×10^{-7}	3.73×10^{-8}	1.75×10^{-8}	1.04×10^{-9}	7.05×10^{-9}
SE	2.04×10^{-5}	1.78×10^{-6}	5.77×10^{-7}	2.92×10^{-7}	1.81×10^{-7}	7.48×10^{-8}	2.63×10^{-8}	1.23×10^{-8}	7.38×10^{-9}	4.99×10^{-9}
SSE	1.20×10^{-5}	1.05×10^{-6}	3.41×10^{-7}	1.73×10^{-7}	1.07×10^{-7}	4.44×10^{-8}	1.57×10^{-8}	7.33×10^{-9}	4.38×10^{-9}	2.95×10^{-9}
S	1.01×10^{-5}	8.79×10^{-7}	2.86×10^{-7}	1.45×10^{-7}	8.96×10^{-8}	3.69×10^{-8}	1.28×10^{-8}	5.85×10^{-9}	3.42×10^{-9}	2.26×10^{-9}
SSW	1.87×10^{-5}	1.63×10^{-6}	5.33×10^{-7}	2.71×10^{-7}	1.68×10^{-7}	6.99×10^{-8}	2.46×10^{-8}	1.14×10^{-8}	6.79×10^{-9}	4.54×10^{-9}
SW	3.54×10^{-5}	3.09×10^{-6}	1.01×10^{-6}	5.17×10^{-7}	3.22×10^{-7}	1.35×10^{-7}	4.84×10^{-8}	2.31×10^{-8}	1.40×10^{-8}	9.53×10^{-9}
WSW	3.10×10^{-5}	2.71×10^{-6}	8.85×10^{-7}	4.50×10^{-7}	2.79×10^{-7}	1.16×10^{-7}	4.14×10^{-8}	1.95×10^{-8}	1.18×10^{-8}	7.96×10^{-9}
W	2.71×10^{-5}	2.37×10^{-6}	7.73×10^{-7}	3.93×10^{-7}	2.44×10^{-7}	1.02×10^{-7}	3.62×10^{-8}	1.71×10^{-8}	1.03×10^{-8}	7.01×10^{-9}
WNW	2.65×10^{-5}	2.32×10^{-6}	7.56×10^{-7}	3.84×10^{-7}	2.38×10^{-7}	9.86×10^{-8}	3.45×10^{-8}	1.60×10^{-8}	9.44×10^{-9}	6.29×10^{-9}
NW	2.24×10^{-5}	1.96×10^{-6}	6.38×10^{-7}	3.24×10^{-7}	2.01×10^{-7}	8.32×10^{-8}	2.92×10^{-8}	1.36×10^{-8}	8.10×10^{-9}	5.43×10^{-9}
NNW	2.83×10^{-5}	2.48×10^{-6}	8.10×10^{-7}	4.12×10^{-7}	2.56×10^{-7}	1.07×10^{-7}	3.81×10^{-8}	1.80×10^{-8}	1.09×10^{-8}	7.38×10^{-9}

Table A-1. Annual average meteorological dispersion/deposition parameters within 80 kilometers of SRP site center (continued)

Direction	Distance(km) 0–2	2–3	3–5	5–6	6–8	8–16	16–32	32–48	48–64	64–80
					Annual average χ/Q, decay, depleted (sec/m^3)					
N	1.80×10^{-5}	1.47×10^{-6}	4.61×10^{-7}	2.26×10^{-7}	1.37×10^{-7}	5.39×10^{-8}	1.75×10^{-8}	7.72×10^{-9}	4.42×10^{-9}	2.88×10^{-9}
NNE	1.87×10^{-5}	1.53×10^{-6}	4.79×10^{-7}	2.36×10^{-7}	1.42×10^{-7}	5.62×10^{-8}	1.83×10^{-8}	8.05×10^{-9}	4.60×10^{-9}	2.99×10^{-9}
NE	2.50×10^{-5}	2.05×10^{-6}	6.40×10^{-7}	3.15×10^{-7}	1.90×10^{-7}	7.51×10^{-8}	2.45×10^{-8}	1.08×10^{-8}	6.21×10^{-9}	4.06×10^{-9}
ENE	2.62×10^{-5}	2.14×10^{-6}	6.70×10^{-7}	3.30×10^{-7}	1.99×10^{-7}	7.88×10^{-8}	2.58×10^{-8}	1.14×10^{-8}	6.54×10^{-9}	4.27×10^{-9}
E	2.28×10^{-5}	1.86×10^{-6}	5.79×10^{-7}	2.84×10^{-7}	1.72×10^{-7}	6.76×10^{-8}	2.20×10^{-8}	9.67×10^{-9}	5.54×10^{-9}	3.61×10^{-9}
ESE	2.68×10^{-5}	2.18×10^{-6}	6.81×10^{-7}	3.34×10^{-7}	2.01×10^{-7}	7.89×10^{-8}	2.55×10^{-8}	1.12×10^{-8}	6.40×10^{-9}	4.16×10^{-9}
SE	1.87×10^{-5}	1.52×10^{-6}	4.76×10^{-7}	2.34×10^{-7}	1.41×10^{-7}	5.55×10^{-8}	1.80×10^{-8}	7.93×10^{-9}	4.54×10^{-9}	2.96×10^{-9}
SSE	1.10×10^{-5}	9.00×10^{-7}	2.82×10^{-7}	1.39×10^{-7}	8.37×10^{-8}	3.31×10^{-8}	1.08×10^{-8}	4.75×10^{-9}	2.72×10^{-9}	1.77×10^{-9}
S	9.29×10^{-6}	7.57×10^{-7}	2.37×10^{-7}	1.17×10^{-7}	7.06×10^{-8}	2.79×10^{-8}	9.05×10^{-9}	3.97×10^{-9}	2.26×10^{-9}	1.46×10^{-9}
SSW	1.72×10^{-5}	1.40×10^{-6}	4.41×10^{-7}	2.18×10^{-7}	1.32×10^{-7}	5.24×10^{-8}	1.72×10^{-8}	7.60×10^{-9}	4.36×10^{-9}	2.84×10^{-9}
SW	3.24×10^{-5}	2.65×10^{-6}	8.35×10^{-7}	4.13×10^{-7}	2.50×10^{-7}	9.96×10^{-8}	3.29×10^{-8}	1.46×10^{-8}	8.46×10^{-9}	5.55×10^{-9}
WSW	2.84×10^{-5}	2.32×10^{-6}	7.29×10^{-7}	3.59×10^{-7}	2.17×10^{-7}	8.60×10^{-8}	2.82×10^{-8}	1.25×10^{-8}	7.17×10^{-9}	4.68×10^{-9}
W	2.48×10^{-5}	2.03×10^{-6}	6.36×10^{-7}	3.13×10^{-7}	1.90×10^{-7}	7.50×10^{-8}	2.46×10^{-8}	1.09×10^{-8}	6.25×10^{-9}	4.09×10^{-9}
WNW	2.43×10^{-5}	1.99×10^{-6}	6.25×10^{-7}	3.08×10^{-7}	1.87×10^{-7}	7.38×10^{-8}	2.41×10^{-8}	1.06×10^{-8}	6.06×10^{-9}	3.93×10^{-9}
NW	2.05×10^{-5}	1.68×10^{-6}	5.26×10^{-7}	2.59×10^{-7}	1.57×10^{-7}	6.18×10^{-8}	2.01×10^{-8}	8.86×10^{-9}	5.07×10^{-9}	3.30×10^{-9}
NNW	2.59×10^{-5}	2.12×10^{-6}	6.67×10^{-7}	3.29×10^{-7}	1.99×10^{-7}	7.89×10^{-8}	2.59×10^{-8}	1.15×10^{-8}	6.59×10^{-9}	4.31×10^{-9}
					Annual average D/Q (m^{-2})					
N	4.31×10^{-8}	3.78×10^{-9}	1.10×10^{-9}	5.08×10^{-10}	2.90×10^{-10}	1.09×10^{-10}	3.14×10^{-11}	1.27×10^{-11}	6.85×10^{-12}	4.26×10^{-12}
NNE	4.22×10^{-8}	3.70×10^{-9}	1.08×10^{-9}	4.97×10^{-10}	2.84×10^{-10}	1.00×10^{-10}	3.07×10^{-11}	1.25×10^{-11}	6.70×10^{-12}	4.16×10^{-12}
NE	5.63×10^{-8}	4.94×10^{-9}	1.44×10^{-9}	6.64×10^{-10}	3.80×10^{-10}	1.34×10^{-10}	4.10×10^{-11}	1.66×10^{-11}	8.95×10^{-12}	5.56×10^{-12}
ENE	6.42×10^{-8}	5.63×10^{-9}	1.64×10^{-9}	7.58×10^{-10}	4.33×10^{-10}	1.53×10^{-10}	4.68×10^{-11}	1.90×10^{-11}	1.02×10^{-11}	6.34×10^{-12}
E	7.11×10^{-8}	6.23×10^{-9}	1.82×10^{-9}	8.39×10^{-10}	4.79×10^{-10}	1.69×10^{-10}	5.18×10^{-11}	2.10×10^{-11}	1.13×10^{-11}	7.02×10^{-12}
ESE	8.44×10^{-8}	7.40×10^{-9}	2.16×10^{-9}	9.96×10^{-10}	5.69×10^{-10}	2.01×10^{-10}	6.15×10^{-11}	2.49×10^{-11}	1.34×10^{-11}	8.33×10^{-12}
SE	4.66×10^{-8}	4.09×10^{-9}	1.19×10^{-9}	5.50×10^{-10}	3.14×10^{-10}	1.11×10^{-10}	3.39×10^{-11}	1.38×10^{-11}	7.41×10^{-12}	4.60×10^{-12}
SSE	2.21×10^{-8}	1.94×10^{-9}	5.66×10^{-10}	2.61×10^{-10}	1.49×10^{-10}	5.25×10^{-11}	1.61×10^{-11}	6.53×10^{-12}	3.51×10^{-12}	2.18×10^{-12}
S	1.65×10^{-8}	1.45×10^{-9}	4.23×10^{-10}	1.95×10^{-10}	1.11×10^{-10}	3.92×10^{-11}	1.20×10^{-11}	4.87×10^{-12}	2.62×10^{-12}	1.63×10^{-12}
SSW	2.93×10^{-8}	2.57×10^{-9}	7.51×10^{-10}	3.46×10^{-10}	1.98×10^{-10}	6.97×10^{-11}	2.14×10^{-11}	8.66×10^{-12}	4.66×10^{-12}	2.90×10^{-12}
SW	6.06×10^{-8}	5.31×10^{-9}	1.55×10^{-9}	7.14×10^{-10}	4.08×10^{-10}	1.44×10^{-10}	4.41×10^{-11}	1.79×10^{-11}	9.63×10^{-12}	5.98×10^{-12}
WSW	6.04×10^{-8}	5.29×10^{-9}	1.55×10^{-9}	7.12×10^{-10}	4.07×10^{-10}	1.44×10^{-10}	4.39×10^{-11}	1.78×10^{-11}	9.59×10^{-12}	5.96×10^{-12}
W	5.46×10^{-8}	4.79×10^{-9}	1.40×10^{-9}	6.44×10^{-10}	3.68×10^{-10}	1.30×10^{-10}	3.97×10^{-11}	1.61×10^{-11}	8.68×10^{-12}	5.40×10^{-12}
WNW	4.20×10^{-8}	3.69×10^{-9}	1.08×10^{-9}	4.96×10^{-10}	2.83×10^{-10}	9.99×10^{-11}	3.06×10^{-11}	1.24×10^{-11}	6.88×10^{-12}	4.15×10^{-12}
NW	3.78×10^{-8}	3.31×10^{-9}	9.68×10^{-10}	4.46×10^{-10}	2.55×10^{-10}	8.99×10^{-11}	2.75×10^{-11}	1.12×10^{-11}	6.01×10^{-12}	3.73×10^{-12}
NNW	5.21×10^{-8}	4.57×10^{-9}	1.33×10^{-9}	6.14×10^{-10}	3.51×10^{-10}	1.24×10^{-10}	3.79×10^{-11}	1.54×10^{-11}	8.28×10^{-12}	5.14×10^{-12}

Table A-2. Population[a] and annual food production[b] within 80 kilometers of the SRP site center

Direction	Distance (km) 0–8	8–16	16–32	32–48	48–64	64–80	0–80
				Population			
N	0	2.34×10^3	3.97×10^3	3.41×10^3	1.04×10^4	3.38×10^4	5.39×10^4
NNE	0	0	1.32×10^3	3.80×10^3	4.96×10^3	2.45×10^4	3.42×10^4
NE	0	0	1.30×10^3	5.79×10^3	9.53×10^3	2.01×10^4	3.68×10^4
ENE	0	0	6.91×10^3	2.35×10^3	9.33×10^3	5.23×10^4	7.09×10^4
E	0	0	3.56×10^3	1.43×10^4	7.17×10^3	8.91×10^3	3.39×10^4
ESE	0	0	7.14×10^3	3.89×10^3	3.21×10^3	5.02×10^3	1.93×10^4
SE	0	0	0	7.14×10^3	5.98×10^3	1.11×10^4	2.42×10^4
SSE	0	0	7.23×10^2	7.65×10^2	5.66×10^2	7.05×10^3	9.10×10^3
S	0	0	1.02×10^3	3.01×10^3	7.80×10^3	4.92×10^3	1.67×10^4
SSW	0	0	2.87×10^2	2.44×10^3	7.03×10^3	3.08×10^3	1.28×10^4
SW	0	0	1.04×10^3	2.95×10^3	2.07×10^3	2.50×10^3	8.56×10^3
WSW	0	0	0	7.81×10^3	2.12×10^3	7.61×10^4	1.75×10^4
W	0	0	2.35×10^3	9.71×10^3	3.05×10^3	1.31×10^4	2.83×10^4
WNW	0	4.05×10^3	3.63×10^3	1.90×10^5	1.16×10^5	2.58×10^4	3.39×10^5
NW	0	1.13×10^3	3.63×10^3	5.01×10^4	7.77×10^3	1.58×10^3	7.44×10^4
NNW	0	3.97×10^3	3.63×10^3	1.25×10^4	1.33×10^4	4.56×10^3	7.29×10^4
TOTAL	0	1.15×10^4	8.54×10^4	3.20×10^5	2.10×10^5	2.26×10^5	8.52×10^5
				Milk production (liters/year)			
N	0	1.64×10^4	1.03×10^5	1.72×10^5	1.41×10^6	5.57×10^6	7.28×10^6
NNE	0	1.31×10^4	1.03×10^5	1.72×10^5	3.68×10^5	6.06×10^5	1.26×10^6
NE	0	5.73×10^3	1.22×10^5	1.33×10^6	2.15×10^6	1.39×10^6	4.99×10^6
ENE	0	1.58×10^3	1.80×10^5	1.92×10^6	4.82×10^6	5.46×10^6	1.24×10^7
E	0	1.85×10^3	1.80×10^5	1.74×10^6	4.15×10^6	5.76×10^6	1.18×10^7
ESE	0	4.51×10	1.80×10^5	9.31×10^5	2.84×10^6	1.46×10^6	5.41×10^6
SE	0	0	1.21×10^5	4.52×10^4	1.80×10^5	4.00×10^5	7.46×10^5
SSE	0	0	9.38×10^4	2.41×10^5	3.52×10^5	5.64×10^5	1.25×10^6
S	0	0	3.31×10^5	5.74×10^5	7.70×10^5	9.97×10^5	2.67×10^6
SSW	0	0	3.58×10^5	1.89×10^6	6.40×10^6	7.41×10^6	1.63×10^7
SW	0	7.65×10^3	3.87×10^5	6.71×10^5	3.07×10^6	2.84×10^6	6.97×10^6
WSW	0	2.47×10^3	3.53×10^5	6.68×10^5	1.05×10^6	2.40×10^6	4.47×10^6
W	0	1.16×10^4	1.81×10^5	3.79×10^5	1.01×10^6	1.77×10^6	3.36×10^6
WNW	0	1.38×10^4	1.79×10^5	3.46×10^5	6.13×10^5	8.55×10^5	2.01×10^6
NW	0	1.75×10^4	1.03×10^5	4.24×10^5	1.16×10^6	7.81×10^5	2.49×10^6
NNW	0	1.79×10^4	1.03×10^5	2.95×10^5	1.48×10^6	3.14×10^6	5.04×10^6
TOTAL	0	1.10×10^5	3.08×10^6	1.18×10^7	3.18×10^7	4.16×10^7	8.84×10^7

a. Population data developed by NUS Corporation using 1970 census data projected to the year 2000.
b. Food production data from du Pont, 1982.

Table A-2. Population[a] and annual food production[b] within 80 kilometers of the SRP site center (continued)

Direction	Distance (km) 0-8	8-16	16-32	32-48	48-64	64-80	0-80
				Meat production (kg/year)			
N	0	8.32×10^4	5.24×10^5	8.73×10^5	1.41×10^6	3.15×10^6	6.05×10^6
NNE	0	6.63×10^4	5.24×10^5	8.73×10^5	2.29×10^6	4.06×10^6	7.81×10^6
NE	0	2.37×10^4	4.71×10^5	7.80×10^5	1.71×10^6	3.01×10^6	5.99×10^6
ENE	0	2.65×10^4	3.02×10^5	5.50×10^5	8.87×10^5	1.06×10^6	2.80×10^6
E	0	3.10×10^3	3.02×10^5	4.74×10^5	6.89×10^5	1.03×10^6	2.50×10^6
ESE	0	7.56×10^1	3.02×10^5	4.66×10^5	6.14×10^5	7.10×10^5	2.09×10^6
SE	0	0	2.74×10^5	3.82×10^5	6.56×10^5	1.00×10^6	2.31×10^6
SSE	0	0	2.35×10^5	4.35×10^5	6.19×10^5	9.88×10^5	2.28×10^6
S	0	0	1.75×10^5	4.58×10^5	7.32×10^5	1.02×10^6	2.39×10^6
SSW	0	0	1.57×10^5	3.93×10^5	1.13×10^6	1.58×10^6	3.26×10^6
SW	0	2.29×10^3	1.33×10^5	2.01×10^5	5.76×10^5	7.57×10^5	1.67×10^6
WSW	0	1.06×10^4	1.75×10^5	2.00×10^5	3.09×10^5	6.65×10^5	1.36×10^6
W	0	5.90×10^4	1.66×10^5	1.19×10^5	2.91×10^5	5.11×10^5	1.15×10^6
WNW	0	7.01×10^4	1.75×10^5	1.09×10^5	1.76×10^5	2.45×10^5	7.75×10^5
NW	0	8.86×10^4	5.24×10^5	6.98×10^5	5.83×10^5	7.01×10^5	2.60×10^6
NNW	0	9.11×10^4	5.24×10^5	8.20×10^5	7.14×10^5	1.45×10^5	3.60×10^6
TOTAL	0	5.01×10^5	4.96×10^6	7.83×10^6	1.34×10^7	2.20×10^7	4.86×10^7
				Vegetable production (kg/year)			
N	0	7.39×10^4	4.65×10^5	7.75×10^5	2.16×10^6	3.11×10^6	6.58×10^6
NNE	0	5.89×10^4	4.65×10^5	7.75×10^5	1.18×10^6	1.61×10^6	4.09×10^6
NE	0	4.13×10^4	9.71×10^5	1.08×10^6	1.59×10^6	1.93×10^6	5.61×10^6
ENE	0	2.25×10^4	2.57×10^6	2.89×10^6	2.21×10^6	2.78×10^6	1.05×10^7
E	0	2.64×10^4	2.57×10^6	3.01×10^6	2.72×10^6	3.03×10^6	1.14×10^7
ESE	0	6.44×10^2	2.57×10^6	3.82×10^6	3.44×10^6	9.66×10^5	1.08×10^7
SE	0	0	2.73×10^6	4.97×10^6	4.70×10^6	2.89×10^6	1.53×10^7
SSE	0	0	2.65×10^6	3.71×10^6	5.01×10^6	3.16×10^6	1.45×10^7
S	0	0	1.36×10^6	1.69×10^6	2.50×10^6	3.27×10^6	8.82×10^6
SSW	0	0	1.15×10^6	1.33×10^6	1.86×10^6	2.55×10^6	6.89×10^6
SW	0	1.51×10^4	9.20×10^5	1.33×10^6	1.81×10^6	1.97×10^6	6.04×10^6
WSW	0	1.01×10^4	7.21×10^5	1.31×10^6	1.86×10^6	2.41×10^6	6.31×10^6
W	0	5.23×10^4	1.86×10^5	3.17×10^5	1.18×10^6	2.77×10^6	4.51×10^6
WNW	0	6.22×10^4	1.94×10^5	1.70×10^5	4.89×10^4	1.36×10^6	1.83×10^6
NW	0	7.86×10^4	4.65×10^5	1.59×10^6	4.20×10^6	2.27×10^6	8.59×10^6
NNW	0	8.08×10^4	4.65×10^5	1.25×10^6	5.70×10^6	6.38×10^6	1.39×10^7
TOTAL	0	5.23×10^5	2.05×10^7	3.00×10^7	4.22×10^7	4.24×10^7	1.36×10^8

a. Population data developed by NUS Corporation using 1970 census data projected to the year 2000.
b. Food production data from du Pont, 1982.

Table A-3. Tenth-year dose (mrem) to maximally exposed individual resulting from atmospheric releases from L-Reactor and its support facilities[a,b]

Pathway	Total body	GI tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
				Adult				
Plume immersion	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	9.44×10^{-2}	1.20
Ground plane	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	2.19×10^{-4}
Inhalation	4.09×10^{-1}	4.05×10^{-1}	1.48×10^{-1}	4.29×10^{-1}	4.25×10^{-1}	4.16×10^{-1}	4.18×10^{-1}	4.05×10^{-1}
Meat ingestion	7.11×10^{-2}	9.08×10^{-2}	2.41×10^{-2}	7.10×10^{-2}	7.16×10^{-2}	1.11×10^{-1}	7.10×10^{-2}	7.10×10^{-2}
Milk ingestion	3.23×10^{-1}	3.22×10^{-1}	2.66×10^{-2}	3.22×10^{-1}	3.22×10^{-1}	5.62×10^{-1}	3.22×10^{-1}	3.22×10^{-1}
Vegetable ingestion	4.63×10^{-1}	4.64×10^{-1}	7.80×10^{-2}	4.59×10^{-1}	4.60×10^{-1}	1.65	4.58×10^{-1}	4.58×10^{-1}
TOTAL	1.35	1.36	3.56×10^{-1}	1.36	1.36	2.82	1.36	2.46
				Teenager				
Plume immersion	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	9.44×10^{-2}	1.20
Ground plane	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	2.19×10^{-4}
Inhalation	4.13×10^{-1}	4.08×10^{-1}	1.55×10^{-1}	4.34×10^{-1}	4.30×10^{-1}	4.16×10^{-1}	4.30×10^{-1}	4.08×10^{-1}
Meat ingestion	4.37×10^{-2}	5.59×10^{-2}	2.03×10^{-2}	4.36×10^{-2}	4.41×10^{-2}	5.91×10^{-2}	4.36×10^{-2}	4.36×10^{-2}
Milk ingestion	4.24×10^{-1}	4.23×10^{-1}	4.89×10^{-1}	4.24×10^{-1}	4.24×10^{-1}	6.29×10^{-1}	4.23×10^{-1}	4.23×10^{-1}
Vegetable ingestion	5.42×10^{-1}	5.44×10^{-1}	1.23×10^{-1}	5.39×10^{-1}	5.40×10^{-1}	1.44	5.37×10^{-1}	5.37×10^{-1}
TOTAL	1.50	1.51	4.26×10^{-1}	1.52	1.52	2.62	1.53	2.61
				Child				
Plume immersion	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	9.44×10^{-2}	1.20
Ground plane	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	2.19×10^{-4}
Inhalation	3.64×10^{-1}	3.60×10^{-1}	1.20×10^{-1}	3.79×10^{-1}	3.75×10^{-1}	3.66×10^{-1}	3.80×10^{-1}	3.60×10^{-1}
Meat ingestion	5.54×10^{-2}	6.28×10^{-2}	3.82×10^{-2}	5.53×10^{-2}	5.59×10^{-2}	6.69×10^{-2}	5.53×10^{-2}	5.53×10^{-2}
Milk ingestion	6.78×10^{-1}	6.77×10^{-1}	1.19×10^{-1}	6.78×10^{-1}	6.78×10^{-1}	8.80×10^{-1}	6.77×10^{-1}	6.77×10^{-1}
Vegetable ingestion	8.63×10^{-1}	8.60×10^{-1}	2.83×10^{-1}	8.57×10^{-1}	8.59×10^{-1}	1.72	8.55×10^{-1}	8.55×10^{-1}
TOTAL	2.04	2.04	6.40×10^{-1}	2.05	2.05	3.11	2.07	3.15
				Infant				
Plume immersion	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	7.92×10^{-2}	9.44×10^{-2}	1.20
Ground plane	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	1.81×10^{-4}	2.19×10^{-4}
Inhalation	2.09×10^{-1}	2.08×10^{-1}	4.79×10^{-1}	2.16×10^{-1}	2.14×10^{-1}	2.12×10^{-1}	2.20×10^{-1}	2.08×10^{-1}
Meat ingestion	0	0	0	0	0	0	0	0
Milk ingestion	1.04	1.04	2.33×10^{-1}	1.04	1.04	1.53	1.04	1.04
Vegetable ingestion	0	0	0	0	0	0	0	0
TOTAL	1.33	1.33	3.60×10^{-1}	1.34	1.33	1.83	1.35	2.45

a. Maximally exposed individual is located on the SRP buffer-zone boundary, 12.6 kilometers west of L-Reactor.
b. For the support facilities, only doses due to L-Reactor operation are included.

Table A-4. Tenth year population dose (mrem) within 80 kilometers of SRP site center resulting from atmospheric releases from L-Reactor and its support facilities[a]

Pathway	Total body	GI tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Plume immersion	1.8	1.8	1.8	1.8	1.8	1.8	3.7	137.0
Ground plane	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06
Inhalation	40.0	39.0	14.0	42.0	41.0	40.0	41.0	39.0
Vegetable ingestion	17.0	17.0	5.5	17.0	17.0	58.0	17.0	17.0
Cow milk ingestion	4.8	4.8	1.7	4.8	4.8	9.1	4.8	4.8
Meat ingestion	3.3	4.1	1.9	3.3	3.3	5.0	3.3	3.3
TOTAL	67.0	67.0	25.0	69.0	68.0	114.0	70.0	201.0

a. For the support facilities, only the doses resulting from L-Reactor operation are included. The population considered is 852,000.

Gases, such as tritium, carbon-14, krypton-85, and iodine-129, will be released from L-Reactor and its support facilities, will persist in the environment for long periods, and will be transported long distances. The population beyond 80 kilometers from the Savannah River Plant can receive radiation doses from these nuclides. Environmental transport and dose models have been adapted for each of these nuclides for this analysis. For each nuclide, the 100-year environmental dose commitment has been calculated. A constant U.S. population of 250 million of the year 2000 has been assumed (DOE, 1978, p. IV-4). Table A-5 lists the results of these calculations.

A.1.1.2 Liquid releases

The NRC LADTAP II computer code (Simpson and McGill, 1980) was used to calculate radiation exposures due to liquid releases; LADTAP II implements the dose models recommended in NRC Regulatory Guide 1.109. Both maximum individual and population doses were calculated as functions of age group and pathway for the total body and appropriate body organs. Age-specific dose conversion factors were used for converting internal exposures to doses. The dose conversion factors are based on NUREG-0172, with revisions for some radionuclides (Hoenes and Soldat, 1977); the age groups considered were the same as those used for the atmospheric release calculations. The exposure to external radiation (e.g., shoreline exposure) is the same for all age groups.

During routine operation of the L-Reactor and its support facilities, radioactive materials will be discharged both to surface streams and to seepage basins. All radioactive materials discharged from facility operations to surface streams discharge into the Savannah River. Radioactive materials discharged to seepage basins will move down to the ground water; gradually they will be transported laterally to outcrop areas along surface streams. After ground water containing radionuclides emerges at these outcrops, it is discharged to the Savannah River. Table A-6 lists ground-water velocities and the distances between the various seepage basins and their respective outcrops for operations associated with L-Reactor. The model for radionuclide transport in ground water uses a one-dimensional analytic solution for the mass transport of radionuclides and their decay products (Burkholder and Rosinger, 1979). Dispersion in the direction of travel was assumed to be zero. Some radioactive decay will occur during transit, thereby reducing the amount of radioactivity discharged. The transport of nuclides can also be impeded by chemical interactions and the adsorptive and absorptive properties of the geologic media through which the ground water flows.

Radionuclide activities at the outcrops were simulated for periods as long as 98,170 years. This period was chosen so all nuclides (even those with retarded movement) emerged at the outcrop. The results for the 30th year were chosen for a detailed radiological dose assessment because the releases of radionuclides from the ground water at the outcrops will be greatest during the later years of L-Reactor operation.

Table A-5. 100-year environmental dose commitment to the U.S. population beyond 80 kilometers of SRP from gaseous effluents from L-Reactor and its support facilities

Nuclide	Curies released per year of operation	Man-rem per year of operation	Organ
H-3	6.43×10^4	30	Total body
C-14	20	14	Total body
Kr-85	2.01×10^5	4.0	Total body
I-129	0.07	1.7	Thyroid

Table A-6. Ground-water migration data for seepage basins

Area	L-Area (100-L)	Central shops (690-G)	Fuel fabri-cation (300-M)	Separations areas 200-F	Separations areas 200-H
Ground-water velocity (m/day)	0.3	0.3	0.3	0.2	0.2
Distance to outcrop (m)	490	365	1220	490	425

Source: du Pont, 1982.

The following pathways were considered in the liquid dose assessments:

- Consumption of water
- Consumption of aquatic foods
- Recreational activities (swimming, boating)
- Shoreline exposure

All individual and population doses were based on the assumption that liquids discharged from L-Reactor and its support facilities are mixed completely in the river before reaching the potential exposure pathways. A dilution factor of 3 was applied to the shellfish dose calculation because a significant portion of the harvest would be from estuarine or ocean waters.

The individual who would receive the maximum potential dose from liquid releases was assumed to live near the Savannah River, downstream from the Savannah River Plant. This individual was assumed to use river water regularly for drinking, to consume river fish and estuarine shellfish, and to receive external exposures from shoreline activities, swimming, and boating.

The total dose received by the offsite population within 80 kilometers of the Savannah River Plant as a result of releases from L-Reactor and its support facilities is estimated by summing the doses to the individuals in the population. The population within an 80-kilometer radius uses no river water for domestic purposes downstream from the Savannah River Plant; this population is assumed to use the river for recreational purposes and to consume fish and shellfish from the river and its estuary.

There is no known use of Savannah River water for human consumption to a distance of about 160 kilometers downstream from the Savannah River Plant. At this distance, Beaufort and Jasper Counties, South Carolina, pump water from the river for treatment and service to a population of about 51,000 people. Several kilometers farther downstream, the Cherokee Hill Water Treatment Plant draws water from the river to supply a business-industrial complex near Savannah, Georgia. This water is not used at present for normal domestic service, but it is assumed that about 20,000 people will use this water during the year 2000. Although these population groups are beyond the 80-kilometer radius, drinking water doses for these groups have been included in this appendix. All population doses are 100-year environmental dose commitments.

Tables A-7 and A-8 list the results of the calculations of doses to the maximally exposed individual and to populations from liquid radioactive releases from L-Reactor and its support facilities during the tenth year of L-Reactor operation.

Radiocesium redistribution

The reactivation of L-Reactor will cause a portion of the radiocesium in the Steel Creek channel and floodplain to be resuspended and transported. The methods used to calculate dose commitments from the radiocesium transport were the same as those used for other liquid releases, except a bioaccumulation factor of 3000 was used for cesium in freshwater fish rather than the value of 2000 recommended in NRC Regulatory Guide 1.109. This higher bioaccumulation factor reflects the results of studies of fish from the Savannah River and Steel Creek performed by the Savannah River Laboratory and the Savannah River Ecology Laboratory (du Pont, 1982; Smith et al., 1982).

Table A-9 lists the results of dose calculations to maximally exposed individuals and to regional populations due to the first year (maximum) radiocesium transport that results from the resumption of L-Reactor operation.

A.1.2 Environmental dose commitment concept

Man can receive doses externally from radioactive materials outside the body or internally from the intake of radioactive material by inhalation or ingestion. Radionuclides that enter the body are distributed to various organs and are removed by normal biological processes and radioactive decay. The rate at which each radionuclide is removed from the body depends on its chemical, physical, and radiological properties. Historically, dose calculations have included an accounting of doses resulting from residual radionuclides in the body for 50 years following the actual intake of the radionuclides. This 50-year "integrating period" is included in the dose commitment factors used in these dose calculations.

Table A-7. Tenth-year population dose resulting from liquid releases from operation of L-Reactor and support facilities (man-rem)[a]

Pathway	Total body	GI tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Drinking water								
Beaufort-Jasper	2.68	2.57	1.60	2.34	2.37	4.11	2.32	
Port Wentworth	1.85	1.81	1.00	1.62	1.64	3.14	1.62	
Total	4.53	4.38	2.60	3.96	4.01	7.25	3.94	—
Sport fish	1.18×10^{-1}	4.54×10^{-2}	2.93×10^{-1}	7.94×10^{-2}	3.76×10^{-2}	1.92×10^{-1}	2.01×10^{-2}	—
Commercial fish	4.48×10^{-3}	1.70×10^{-3}	1.10×10^{-2}	3.08×10^{-3}	1.44×10^{-3}	7.47×10^{-3}	7.81×10^{-4}	—
Shellfish	1.90×10^{-4}	3.16×10^{-3}	2.47×10^{-3}	7.78×10^{-5}	2.68×10^{-4}	1.16×10^{-3}	2.56×10^{-5}	—
Shoreline	3.23×10^{-3}	—	—	—	—	3.23×10^{-3}	—	3.92×10^{-3}
Swimming	1.05×10^{-5}	—	—	—	—	1.05×10^{-5}	—	—
Boating	3.69×10^{-5}	—	—	—	—	3.69×10^{-5}	—	—
TOTAL	4.66	4.43	2.91	4.04	4.05	7.45	3.96	3.92×10^{-3}

a. For the support facilities, only the dose contribution due to L-Reactor operations are included.

Table A-8. Tenth-year dose to maximally exposed individual resulting from liquid releases from L-Reactor and support facilities (millirem)[a]

Pathway	Skin	Bone	Liver	Total body	Thyroid	Kidney	Lung	GI-LLI
				Adult				
Fish	—	7.02×10^{-2}	1.64×10^{-2}	2.84×10^{-2}	4.74×10^{-3}	8.56×10^{-3}	4.27×10^{-3}	1.26×10^{-2}
Shellfish	—	6.35×10^{-2}	2.03×10^{-3}	5.91×10^{-3}	3.61×10^{-2}	7.19×10^{-3}	6.99×10^{-4}	9.53×10^{-2}
Drinking	—	7.27×10^{-2}	1.10×10^{-1}	1.25×10^{-1}	2.12×10^{-1}	1.11×10^{-1}	1.09×10^{-1}	1.23×10^{-1}
Shoreline	1.09×10^{-4}	9.25×10^{-5}	9.25×10^{-5}	9.25×10^{-5}	9.25×10^{-5}	9.25×10^{-5}	9.25×10^{-5}	9.25×10^{-5}
Swimming	0.	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}
Boating	0.	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}
TOTAL	1.09×10^{-4}	2.06×10^{-1}	1.29×10^{-1}	1.59×10^{-1}	2.96×10^{-1}	1.27×10^{-1}	1.14×10^{-1}	2.31×10^{-1}
				Teenager				
Fish	—	6.39×10^{-2}	1.60×10^{-2}	2.15×10^{-2}	2.46×10^{-2}	7.98×10^{-3}	3.82×10^{-3}	1.00×10^{-2}
Shellfish	—	6.47×10^{-2}	1.88×10^{-3}	5.59×10^{-3}	1.83×10^{-2}	7.27×10^{-3}	5.38×10^{-4}	7.65×10^{-2}
Drinking	—	5.96×10^{-2}	7.73×10^{-2}	9.00×10^{-2}	1.25×10^{-1}	7.91×10^{-2}	7.70×10^{-2}	8.74×10^{-2}
Shoreline	6.11×10^{-4}	5.17×10^{-4}	5.17×10^{-4}	5.17×10^{-4}	5.17×10^{-4}	5.17×10^{-4}	5.17×10^{-4}	5.17×10^{-4}
Swimming	0.	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}
Boating	0.	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}
TOTAL	6.11×10^{-4}	1.89×10^{-1}	9.57×10^{-2}	1.18×10^{-1}	1.68×10^{-1}	9.49×10^{-2}	8.19×10^{-2}	1.74×10^{-1}
				Child				
Fish	—	6.57×10^{-2}	1.34×10^{-2}	1.71×10^{-2}	1.31×10^{-2}	6.69×10^{-3}	3.07×10^{-3}	5.12×10^{-3}
Shellfish	—	8.47×10^{-2}	1.76×10^{-3}	6.54×10^{-3}	9.75×10^{-3}	6.80×10^{-3}	4.61×10^{-4}	3.33×10^{-2}
Drinking	—	1.38×10^{-1}	1.48×10^{-1}	1.77×10^{-1}	2.03×10^{-1}	1.52×10^{-1}	1.47×10^{-1}	1.58×10^{-1}
Shoreline	1.28×10^{-4}	1.08×10^{-4}	1.08×10^{-4}	1.08×10^{-4}	1.08×10^{-4}	1.08×10^{-4}	1.08×10^{-4}	1.08×10^{-4}
Swimming	0.	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}	1.10×10^{-6}
Boating	0.	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}	3.30×10^{-6}
TOTAL	1.28×10^{-4}	2.89×10^{-1}	1.63×10^{-1}	2.01×10^{-1}	2.26×10^{-1}	1.66×10^{-1}	1.51×10^{-1}	1.97×10^{-1}
				Infant				
Fish	0	0.	0.	0.	0.	0.	0.	0.
Drinking	0	1.21×10^{-1}	1.46×10^{-1}	1.70×10^{-1}	2.32×10^{-1}	1.49×10^{-1}	1.45×10^{-1}	1.51×10^{-1}
Shoreline	0	0.	0.	0.	0.	0.	0.	0.
TOTAL	0	1.21×10^{-1}	1.46×10^{-1}	1.70×10^{-1}	2.32×10^{-1}	1.49×10^{-1}	1.45×10^{-1}	1.51×10^{-1}

a. For the support facilities, only the dose due to L-Reactor operations are included.

Table A-9. First-year dose from radiocesium transport

Pathway	Total body	Skin	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI
			Maximum individual dose (mrem)					
Adult	4.8	0.004	5.4	7.3	0.004	2.5	0.82	0.15
Teenager	2.7	0.02	5.7	7.6	0.02	2.6	1.1	0.13
Child	1.1	0.005	7.3	7.0	0.004	2.3	0.82	0.05
Infant	0.018	—	0.18	0.23	0	0.06	0.02	0.006
			Population dose (man-rem)					
Drinking water								
Port Wentworth	0.82	—	0.93	1.2	0	0.41	0.12	0.02
Beaufort-Jasper	0.93	—	1.8	2.0	0	0.7	0.23	0.03
Sport fish	18.9	—	29	36	0	12	0.2	0.6
Commercial fish	0.76	—	1.1	1.4	0	0.46	0.18	0.02
Shellfish	0.0003	—	0.0005	0.006	0	0.0002	0.00006	0.00001
Shoreline	0.18	0.18	—	—	0.18	—	—	—
Swimming	0.0001	—	—	—	0.0001	—	—	—
Boating	0.0004	—	—	—	0.0004	—	—	—
TOTAL	22	0.18	33	41	0.18	14	4.7	0.64

The radioactive material remains in the environment for varying lengths of time, depending on many environmental factors and on the decay rate of each radionuclide. The EDC concept can be employed to account for this residual activity.

The EDC concept has been developed by the U.S. Environmental Protection Agency (EPA, 1974). The Agency has defined the environmental dose commitment as "... the sum of all doses to individuals over the entire time period the material persists in the environment in a state available for interaction with humans." The EPA report describes how this concept is implemented and presents some sample calculations. These calculations integrate doses for only 100 years following radionuclide release rather than "the entire time period." This 100-year integrating period is separate from the 50-year integrating period discussed above because it deals with the accumulation of doses from residual radioactivity in the environment rather than in the body.

The 100-year integrating period was used in this analysis; in other words, all population dose calculations will include an accounting of population doses caused by environmental radioactivity levels for 100 years following each year's release. The 100-year period provides results that are meaningful by accounting for impacts over a period of time about equal to the maximum lifetime of an individual; thus it provides a measure of risk to an individual. Longer integrating periods or an infinite time integral would require extremely speculative predictions about man's environment for thousands of years into the future.

For all EDC calculations, no attempt was made to predict changes in environmental characteristics. Population size and distribution were based on the latest estimates. Historic meteorology was assumed to continue into the future. Food production and consumption patterns were assumed to be static.

A.2 IMPACTS OF POSTULATED ACCIDENTS

A.2.1 Radiation doses

The principal pathways for radioactivity to reach an individual at the SRP site boundary are (1) the exposure to noble gases (xenon, krypton) in the air, (2) the inhalation of radionuclides, principally iodine and tritium, (3) the inhalation of particulate nonfission products, principally plutonium-238 and plutonium-239, and (4) the absorption of tritium through the skin.

Dose conversion factors are based on widely accepted values published in ICRP-2 and in NUREG-0172.

The values recommended for the exclusion area in NRC's Reactor Site Criteria (10 CFR 100) are used to compare the doses that could be received at the site boundary from an accidental release. The "exclusion area" is that area in which the agency has the authority to exclude or remove personnel and property. According to 10 CFR 100, the exclusion area must be of such a size that for a fission product release from a major accident, which is assumed to result in a substantial meltdown of the core, the dose within the first 2 hours to an individual at the site boundary would be less than 25 rem to the whole body or 300 rem to the thyroid from iodine exposure. Therefore, a 2-hour period of radioactivity release is assumed, which includes a 2-hour period of partial desorption of iodine from the carbon beds.

A.2.2 Source terms

The source terms of fission products (xenon, krypton, iodine) are calculated for the full reactor-power-inventory values. The source terms for nonfission products (plutonium-238, plutonium-239, and tritium) are based on the maximum expected content in the reactor for normal reactor production.

A.2.2.1 Tritium source term

The calculated maximum equilibrium inventory of tritium in the reactor moderator is 5×10^6 curies. The current inventory of tritium in an operating SRP reactor is about 3.5×10^6 curies. At the beginning of L-Reactor operation, the tritium inventory will be near zero; it will increase gradually to near the equilibrium value over a period of 5 to 7 years. A mass transfer calculation of the amount of moderator that would evaporate over the assumed 2-hour period gives a value of 3.3 percent for the expected air flow, surface area, temperature, and humidity conditions in the reactor building.

The tritium in the evaporated moderator would be released from the stack.

A.2.2.2 Iodine source term

Source terms are calculated for the full-power equilibrium value of iodine in the reactor core. In a core-melt accident, 50 percent of the equilibrium value is assumed to be available immediately for transport to the activity confinement system.

Test results on the SRP carbon bed system are used to calculate the amount of filter bypass that would be expected (0.05 percent), and the amount of iodine that would desorb over the 2-hour period.

A.2.2.3 Noble gas source terms

The full equilibrium inventory value of noble gas is used.

A.2.2.4 Particulate nonfission product source terms

The nonfission product isotopes of plutonium-238 and plutonium-239 are considered in the postulated core-meltdown accidents. The following assumptions are made: 1 percent of the amount melted is released to the building, 50 percent of that amount plates out, and the HEPA filters are 99 percent efficient for these particulates.

A.2.3 Transport

Standard transport equations, such as those presented in NRC Regulatory Guide 1.3, are used to calculate the dilution of the radioactivity at the site boundary. A 2-year SRP data base was used to compute the meteorological conditions. This data base included wind speed, direction, and stability for 32 sectors for 15-minute time intervals. The data collected over the 2-year period totaled 52,000 sets of meteorological data.

A.2.4 Dose calculations

Each of the 52,000 sets of meteorological data was used to calculate the dose at the site boundary. Doses were calculated for the whole body (tritium, noble gas, particulates) and for the thyroid (iodine). The calculated accident doses are distributed statistically, and the 50th-percentile value is used to produce the results listed in Table 4-10, as suggested in NRC Regulatory Guide 4.2.

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